Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

SOME REMARKS ON THE LIMITATION OF TUBERCULOSIS,

ILLUSTRATING THE VALUE OF THE MICROSCOPE IN PREVENTIVE MEDICINE.*

W. W. ALLEGER, M. D.,

Lecturer on Bacteriology, Medical Department, Howard University,
Washington, D. C.

Perhaps in no field of science has the microscope unfolded facts of so much importance and great interest as in the field of bacteriology, and certainly no branch of learning has ever enlisted so many able workers, nor accomplished so much of value to mankind in so brief a time, as has this branch of medicine within the past decade or two.

The discovery of bacteria in 1675, by Leeuwenhoek, was coincident with and dependent upon improvement in the construction of microscopic lenses; and, from that day to this, there has existed a mutual dependence between the achievements of the optician and the advancement of the student of bacteriology.

Although a linen-draper by apprenticeship, Leeuwenhoek, in his spare moments applied himself to the art of grinding lenses with such success as to produce magnifying glasses which not only surpassed any hitherto made, but that were of such high degree of curvature and perfection as to reveal the micro-organisms now known as bacteria in a drop of rain water, and even the minuter forms found in the intestinal tract of birds and frogs, in his own diarrhœal evacuations, and in other substances and fluids containing organic matter which he was led to examine.

These discoveries and the controversies which afterward arose regarding the question of spontaneous generation, led to extended studies into microscopic forms of life and created a demand for magnifying glasses of higher power and better definition, which stimulated efforts looking toward the improvement of the microscope; and, as from time to time improvements in construction have been accomplished or advances in technique have been made, our knowledge of microscopic forms of life has been increased until the vast storehouse of material belonging to the domain of bacteriology has been erected and ways have been opened up, the importance and end of which, in the amelioration of suffering and betterment of the human race, no man can foretell.

---

*This article attracted public interest and was published in full in several of the Brooklyn newspapers.

Of late, each year brings forth from the numerous laboratories of the world many facts shedding light upon the biological characteristics of the different forms of bacteria and the role enacted by them in nature. Especially with the known pathogenic species are we becoming well acquainted and are learning their modes of action in bringing about the changes in the fluids and cells of the body which are the expressions of the specific diseases that they induce. This is not only leading to a better understanding of morbid processes, but in some instances to improved and more effective methods of treatment, and in others to the adoption of precautionary measures for the prevention of the spread of contagious diseases, the far reaching importance of which is inestimable.

Following the detection of rod-shaped bacteria in the blood of animals dead of anthrax by Pollender in 1849, and by Davaine in 1850, Pasteur discovered that not only were these organisms capable of inducing an attack of anthrax in a susceptible animal after cultivation on suitable media outside of the animal body, but that their virulence could be so modified by cultivation as to produce an attack so mild as to cause no injury to the animal and yet render it immune against virulent cultures subsequently introduced, and which otherwise would prove fatal, a discovery that has been of great value to industrial interests and laid the foundation for greater conquests in the field of medicine.

Enlarging on Pasteur's work, Koch, who discovered the bacillus of tuberculosis, carried out extensive experiments which seemed to show that this disease might be arrested by means of injections of an extract of the filtered cultures of the tubercle bacilli. Such injections in persons afflicted with tuberculosis were followed by beneficial results in some cases, but in others were either without effect or what was worse, positively injurious, so that the hopes of the great savant that a panacea for the cure of consumption had at last been discovered were not realized. Nevertheless, his studies, whichwere so thorough that not a single material fact relative to the biological characteristics of the bacilli and their relation to the disease has since been added by the scores of competent workers in the field, were of great importance and placed us in possession of information which clearly revealed the nature and cause of the disease.

When we consider that tuberculosis causes more deaths than any other disease, being directly responsible for one-seventh of the mortality of the globe and fully one-fourth of the deaths occurring between the ages of 20 and 40 years, it is not surprising that much interest was awakened in the subject. While some have continued the search for a specific for the cure of the disease, others, believing it better to prevent than to cure, and recognizing the difficulties yet to be overcome in its successful management, have turned their attention to its limitation.

Although we have at our command—thanks to Koch's work—the means to wage a fairly successful warfare against the spread of tuberculosis, the evil is so wide spread and deep seated, and mankind has become so inured to its ravages and have so long regarded it as hereditary and unavoidable that it is very difficult to overcome the apathy thus engendered and secure the vigorous and efficient coöperation essential to the successful prosecution of the work. Moreover, being an essentially chronic disease the measures necessary to its control become irksome and hence hard to enforce, particularly among the indifferent and incredulous. If one-tenth part of the deaths occurred in a given community from some acute disease such as small-pox, yellow fever or cholera, as annually occur therein from tuberculosis, there would be a popular uprising which would secure the adoption of every known measure for its control or eradication ; but against the insidious inroads of this familiar scourge, with all the long standing and firmly fixed prejudices and erroneous ideas to combat that have been erected around it, the case is otherwise. As it is, it is necessary to educate the masses as well as to enlist the services of the medical profession, and to secure the adoption by national, state and municipal authorities of such regulations as are essential to accomplish the end in view. This is what advanced writers and workers of the day are endeavoring to do.

The first essential to success in formulating measures to limit the spread of an infectious disease is a clear understanding of the nature of the infectious agent, the conditions under which it is capable of setting up the morbid processes and the channels of infection.

To my mind the fact that the bacillus tuberculosis is the essential cause of tuberculosis has been settled beyond cavil. And, although many still entertain the idea that the relation between this bacillus and the disease in question is a matter about which there exists much doubt ; and notwithstanding that certain authorities (who evidently are unfamiliar with bacteriological technique) have recently come forward with the statement that tubercle bacilli bear no more relation to tuberculosis than do certain other micro-organisms ; that tuberculosis may and does occur without the presence or intervention of the tubercle bacilli ; and that in carrying out measures of prophylaxis disinfection may safely be disregarded ; no fact in general pathology rests upon a firmer foundation than that an etiological relationship exists between those organisms and this disease. Not only are they always present in this disease and absent from non-tubercular lesions, but when isolated in pure culture, even through many generations, and then introduced into the bodies of susceptible animals, they are capable of causing the disease in the creatures thus inoculated. This is considered a crucial test and has been successfully performed over and over again by scores of competent observers in several different countries. In fact it is a part of the practical work of most of the advanced medical colleges annually carried out.

There are many causes which may predispose an individual to the development of tuberculosis ; but no one of these nor all of them combined wlll suffice to determine an attack of this disease unless the bacillus tuberculosis is superadded. Lesions simulating tuberculosis may be produced but not the true disease. A minute quantity of material from one of these pseudo-tubercles introduced into the body of a susceptible animal will not give rise to tuberculosis ;

while if an equal amount of material from a true tubercle is introduced, the result will be tuberculosis in the inoculated animal.

In addition to the experimental data, clinical evidence has been accumulated which is deemed sufficient to establish the communicability of tuberculosis. And, if communicable, how shall we explain the power of tuberculosis to propagate itself, in the light of our present knowledge, except upon the theory that the disease is due to a *contagium vivum*.

In response to a question as to contagion, asked by the committee of the British Medical Association, 261 replies in the affirmative were received, among which were 158 cases of supposed contagion through marriage. Of these Weber's cases were of special interest. One of his patients lost four wives in succession ; one three ; and four, two each.

In the Municipal works of Paris, Arthaud found that 32 workmen out of 38 employed were tuberculous. Four of these cases were of long standing and had apparently infected the others ; at least 23 of them had contracted the disease after entering the factory.

Of 118 samples of dust collected from the walls and bedsteads of hospital wards and rooms of phthisical patients by Cornet, 40 were infective and produced tuberculosis on being inoculated into susceptible animals. With the 29 samples collected from localities only occasionally visited by consumptives the results of inoculation were all negative. Virulent bacilli were obtained in 15 out of 21 medical wards. In two wards containing several consumptives the results were negative.

The following instructive case is related in a recent number of the British *Medical Journal*: A family of nine occupied a house previously inhabited by two tuberculous patients. A short time after, although the entire family had been in splendid health, three among them showed symptoms of tuberculosis. They used the same bed room as the previous tenants. Dr. Ducor had pieces of wall paper and dust from the ceilings and wall examined, and tubercle bacilli were found in both cases. The former occupants had been uncleanly in their habits ; the sputa had dried on the walls, and the bacilli had retained their vitality as was shown by M. Vignal, who investigated the matter.

Another clinical observation of interest is the fact that patients received into the wards of general hospitals with tubercular patients sometimes contract tuberculosis during their stay, and are discharged cured of the original malady, only to find themselves victims of tuberculosis ; or, if their stay has been more protracted, remain only to succumb to the latter disease. Biggs calls attention to the frequent occurrence of such cases in the hospitals of New York, and the writer has observed a few similar instances in the hospitals of Washington.

Hirschberger reports the case of an owner of a herd of cattle known to be tuberculous, who withdrew the milk from market and used it without boiling to fatten his pigs, which, almost without exception, became tuberculous, so that the whole stock had to be slaughtered.

Among the novel sources of infection are bedbugs. Dewevre relates an example. Tuberculosis having occurred in a young man occupying the bed of his brother who had died of this disease, but in a room thoroughly disinfected, the inefficiency of the disinfection was explained when an inspection of the corpse showed that it was covered with the bites of bedbugs, and that his bed, which had escaped disinfection, was filled with these animals. Thirty of the bugs were gathered and inocculated in three guinea pigs, which soon died of tuberculous. Sixty per cent. of the bugs were found to be tuberculous. In the other series of experiments the animals were placed in contact with sputum, and some weeks afterward virulent cultures were obtained from them. If bugs can transmit the disease from one to another, they may furnish the missing links in cases not otherwise explicable.

Statistics show that tuberculosis increases in frequency as we ascend from those occupations involving an isolated out-of-door existence, to those requiring greater confinement and closer personal contact. In every thousand deaths from all causes occurring in farmers 103 are due to pulmonary tuberculosis ; in fishermen, 108 ; in gardeners, 121 ; in agricultural laborers, 122 ; in grocers, 167 ; in tailors, 290 ; in drapers, 301 ; in printers and compositors, 461 ; and among the Cornish miners over sixty per cent. Inmates of convents, prisons, etc., also have an appalling percentage of deaths from tuberculosis to report.

In view of all the facts it seems idle to deny an etiological role to the bacillus tuberculosis, and pernicious to omit measures looking to its exclusion and destruction in connection with the prevention of tuberculosis and the care of those suffering with the disease.

The popular idea that tuberculosis is generally inherited is not concurred in. While we do not say that the direct transmission of the disease from parent to offspring is impossible, yet we do affirm that it is at least of comparatively infrequent occurence. It is true that a specially vulnerable or invulnerable type of tissue may be and is inherited, the former rendering the individual liable to infection, the latter conferring partial or complete immunity from it. In the one case the seed, when sown, falling on good ground bears fruit not an hundred, but many million fold ; in the other, falling by the roadside or on stony ground, either fails of growth altogether or develops to a limited extent only.

The bacillus tuberculosis is a minute rod-shaped, unicellular vegetable organism, varying from 1.5 to 3.5 micromillimeters in length, and about 0.2 of a micromillimeter in breadth. Some of the rods are straight, others slightly curved while a few present a beaded appearance resembling a short chain of streptococci. They do not grow out into long filaments as do many bacilli, but are found lying singly, in pairs having no definite relation to each other, or in small clumps. They are so minute that it is difficult to recognize them in their unstained condition, but fortunately their staining peculiarities are so distinctive that their detection and differentiation from other bacilli is a matter of but little difficulty. They are strict parasites and do not find in nature suitable conditions for their growth and multiplication outside of the bodies of susceptible persons and animals ; although they can be cultivated in the laboratory when planted on special media, kept uniformly at the body temperature and protected from light. Exposure to the direct rays of the sun destroys their vitality in a few minutes or hours according to the thickness of the layer of sputum or the nature and amount of the other material with which they have been deposited, while a bright diffused light also renders them inert after a variable but longer time ; but they retain their vitality and virulence for months and even years in rooms that have been inhabited by tuberculous persons, particularly in crevices and dark recesses where they are protected from the action of strong rays of light.

The bacilli gain entrance to the organism in some instances through the meat and milk of infected animals, in which case they may set up in susceptible persons, especially in children, tuberculosis of the bowels; another occasional mode of infection is through the inoculation of fresh wounds or abraded surfaces; but in the vast majority of cases the portal of entry is through the respiratory organs by means of the inhalation of dust laden with the bacilli or their spores. Having once gained access to vulnerable tissues—whether that vulnerability has been inherited or acquired—they become lodged in the finer ramifications of the capillaries or in the minute lymph spaces where they multiply and develop, elaborating from the albuminoid materials in the fluids of the host, poisons of a chemical nature which irritate and cause the death of the tissue cells at the point of lodgment. The reaction of the organism in consequence of the irritation thus set up causes the emigration to the part of leucocytes and the proliferation of the local tissue cells, the result being a small nodule having a necrotic center surrounded by a zone of granulation tissue composed of small round or ovid cells, with, in many instances, a few giant cells imbedded in a fibrin-like network of connective tissue. The small nodules or tubercles thus formed, and which constitute the essential lesions of tuberculosis, may coalesce and form larger nodules; they have a tendency to undergo caseous degeneration and break down, and the detritus, containing large numbers of the bacilli, is thrown off with the sputum in cases of pulmonary tuberculosis, or with the milk, urine or stools in cases of tubercular ulceration of the milk glands, kidneys or bowels. Microscopic examination of properly stained preparations reveals the bacilli within the giant cells, and at the periphery of the necrotic area of the tubercles, as well as in the effete material thrown off by nature.

The bearing of these facts upon the measures to be adopted for the restriction of tuberculosis is obvious. Of greatest importance is the disinfection or destruction of the sputa and other infectious material that it may not be allowed to soil the floor and become dry and pulverized, as under such circumstances the air of the room, laden with dust bearing the infectious agent, becomes a source of danger to the non-tuberculous persons in the apartment, as well as to the patient himself, whose chances of recovery are diminished by reason of constant reinfection through germs which nature has once expelled; next in order is the destruction or proper disposal of infected cattle. If this could be thoroughly done there is little doubt but that this monstrous scourge could be eliminated from the face of the earth. But while the hope of complete eradication cannot now be entertained, we may at least hope for as much success as has been attained in limiting the spread of small-pox, cholera and other infectious diseases. We do not underestimate the importance of measures of general hygiene, and are not unmindful of the fact that while tuberculosis is communicable it is so to a much less extent than measles, scarlet fever, small-pox, etc., to which the term contagious is more properly applied; and we are aware that it generally requires for its development long and close contact with the sources of infection; or, in addition to exposure, the operation of some depressing agent or source of irritation sufficient to overcome the natural resistance of the organism and render the tissues vulnerable. For this reason especial care should be exercised to avoid all possible sources of infection during the existence of disorders of the respiratory organs or while suffering or convalescing from any of the exanthemata, whooping cough, diabetes, or other diseases likely to lay the foundation for the development of tuberculosis.

Persons suffering from tuberculosis should not be permitted to work in close apartments with other workmen. Their presence in such places constitutes a source of danger to their associates and their own chances of recovery are diminished by the confinement and autoinfection. Nor should they engage in any occupation in which they will especially endanger others.

Separate hospitals should be erected for the treatment of tuberculosis as it occurs among the poor, and these should be erected in dry, healthy locations, surrounded by spacious grounds, the rooms well ventilated and an abundance of sunshine admitted.

Rooms vacated by tuberculous patients should be disinfected before being reoccupied.

Clothing soiled with the sputa or other infectious material should be exposed to steam, hot air or formalin vapor or solution.

Tableware used by tuberculous patients should be placed in boiling water for a few minutes before being washed with other dishes.

Kissing should be avoided.

Tuberculous mothers should not nurse their infants.

Dairies and abattoirs should be rigidly inspected by competent agents appointed by the state, national or municipal authorities and all diseased milch cows and infected meat should be promptly condemned and properly disposed of. Meat should be thoroughly cooked and never eaten rare, unless the animals slaughtered are known to have been free from tuberculosis. Milk coming from dairies that have not been properly inspected should not be used, especially by young children, without first being boiled or, what is preferable, the quality of the milk being considered, kept at 70 C. for half an hour.

When on the street or away from home the sputa should be received in paper napkins and deposited in a tight metal box carried for the purpose. Immediately on arriving home the napkins should be burned and the box disinfected by dry heat, formalin or boiling water.

Isolation or quarantine is not necessary. The expired air from the lungs of the sufferer from tuberculosis *does not contain the germs of the disease*, and there is no danger to the most intimate associates so long as contact with the sputa is avoided.

As an evidence of the interest manifested in the subject it is pleasing to note that measures have recently been adopted by the authorities of Prussia, Germany and Russia, to limit the spread of tuberculosis. That the Michigan State Board of Health have declared it to be a contagious disease and included it among those in which compulsory notification is required. That the New York City Health Department has determined to inaugurate advanced measures for its active surveillance, and the Department of Charities and Correction of New York has at the same time signified its intention of settting apart a hospital for the exclusive treatment of consumption as it occurs among the poor. That the Board of Health of Philadelphia has issued a circular showing the number and percentage of deaths from tuberculosis as contrasted with other infectious diseases, stating the chief sources of infection, and giving full directions as to the disinfection of the sputa, tableware, clothing and rooms of tubercular patients. That in this city (Washington) it is included in the Regulations of the Board of Health among the contagious diseases requiring precautionary measures against their spread; and at least one of our public hospitals (Freedman's) has caused the segregation of its cases of tuberculosis, and the adoption of other appropriate measures to prevent the infection of the other patients. That the State of New York has enacted a law requiring the inspection of cattle and the destruction of those found to be tuberculous. And that at the Pan-American Medical Congress recently held in this city the following resolution was adopted:

"*Resolved*, That it is the view of the Section on Hygiene that in view of the fact that tuberculosis causes more deaths than any other disease, that it is known to be communicable, especially to persons living in houses and shops with consumptives, that the attention of national, state and municipal authorities be directed to the necessity of controlling the dissemination of the disease:

"1st.—By notification by physicians and householders.

"2d.—By regulation of the residences of the tuberculized.

"3d.—By controlling their movements as far as possible.

"4th.—By the establishment of hospitals and homes for the infected poor."